

**REMARKS**

Reconsideration is respectfully requested in light of the amendments and remarks which follow. Entry of the amendment and the declaration is respectfully requested since the issues on appeal would be reduced and the submission of the declaration is timely.

Claims 1-41 are pending. Claims 1-13, 15-22 and 26-41 stand withdrawn from consideration. Claims 14 and 23-25 are rejected.

By this response, claim 14 is cancelled and claim 23 amended in the manner suggested by the Examiner.

It is noted that the Office Action was made final and contained new grounds of rejection employing new art and including a request for a specific experimental comparison. "Fairness" suggests that Applicants be given an ample opportunity to respond by allowing entry of the claim amendments, which address one or more of the new rejections, and entry of the declaration, which provides the requested showing. Reconsideration and withdrawal of the finality of the Office Action are respectfully requested.

***Rejection under 35 U.S.C. § 112***

Claims 14 and 23-25 are rejected under 35 U.S.C. § 112, first paragraph, as failing to comply with the written description requirement. Applicants respectfully traverse.

The cancellation of claim 14 moots its rejection.

The amendment of claim 23 moots its rejection since the terminology questioned has been replaced with terminology expressly supported within the specification as filed.

Reconsideration is respectfully requested.

***Rejection under 35 U.S.C. § 103(a)***

Claims 14 is rejected under 35 U.S.C. § 103(a) as unpatentable over Forray (US 2004/0102566) in view of *Sakurai* (JP 2003-0490939). Applicants respectfully traverse.

Claim 14 has been cancelled mooted the rejection.

Claims 14 and 23-25 are rejected under 35 U.S.C. § 103(a) as unpatentable over *Herr et al.* (US 6,265,530) in view of *Sakurai* (JP 2003-040939) and further in view of *Chan* (US 5,006,575). Applicants respectfully traverse.

The underlying rationale for the rejection is the assertion that the selection of the claimed bis-maleimide compound (B') would have been obvious. *Sakurai* and *Chan* are cited to support this assertion. *Chan* is newly applied in this regard.

The comments a)-d) in the "Response to Arguments" section of the outstanding Office Action have been considered including the suggested comparison where the bis-maleimides of *Sakurai* are substituted for those of *Herr*. A Rule 132 declaration having the requested comparison has been enclosed.

Applicants submit that there is insufficient guidance and motivation to have lead one of ordinary skill to select the claimed bis-maleimide compounds having formula (3) from the myriad of compound possibilities taught by *Herr et al.*, especially when one considers the uniqueness of the formula 3 bis-maleimide compounds and the unexpected benefits achieved by their use in the claimed adhesive composition. Further, there is no structure, activity correlation taught in the art relied upon to suggest a compound having formula (3).

#### Compound (B) of the Invention

Compound (B) is the bis-maleimide compound (B') having the structure represented by formula (3), which shows good crosslinking reactivity, good adhesion to metal surfaces, a good balance the effect of adhesion and viscosity, low crystallinity, good thermal conductivity even in polar solvents. The bis-maleimide compound (B') has a polyether structure that contains a -O- group as X<sup>2</sup> in formula (3), so that the resin composition is likely to be a liquid and a cured product thereof has excellent low stress property.

Herr et al.

The bismaleimide compounds disclosed in Herr et al. encompass a wide variety of compounds and include, as a preferred example, a maleimide compound having an aromatic ring, which for Applicants' purposes is deleterious and excluded. Also included in teachings of Herr et al. are maleimides with siloxane or urethane structure. These are suitable for Herr et al.'s purpose but not Applicants'. There is no structure-activity correlation that would lead one to a structure like that claimed.

Sakurai

Various kinds of maleimide compounds are mentioned in Sakurai. Trifunctional or more maleimide compounds and a maleimide compound having an aromatic ring other than an imide ring are used in the examples, which are not preferable in the present invention. Also in Sakurai, an adhesive is mentioned as an application of the composition. In Sakurai, however, the applications of the resin composition also include print ink, paint and coating agent. There is no mention of an application as an adhesive for semiconductor elements and heat dissipating members.

Chan

Chan teaches a solid adhesive composition suitable for the very rapid attachment of IC chips to high surface energy substrates comprising flake silver particles dispersed in solid matrix- thermoplastic phenoxy resin and thermally cross-linkable resin.

Structure-activity correlations

The resin composition of the present invention is used as an adhesive for bonding semiconductor elements and/or heat dissipating members and the components of the resin composition are selected and combined carefully so that the properties for the taught application

are enhanced. In particular, the bismaleimide of the invention is designed from the following view point.

First, the bismaleimide compound (B') has two maleimide groups. Therefore, when compared to a compound having one maleimide group, it increases the adhesion of the resin composition; moreover, when compared to the situation where a compound has three or more maleimide groups, the bismaleimide compound (B') does not increase the viscosity of the resin composition. An adhesive for the semiconductor and heat dissipating member which shows excellent coating performance to bond fine members and viscosity is an important factor that influences the coating performance.

In the bismaleimide compound (B'), no aromatic ring is contained in the group which connects the two maleimide groups; therefore, the bismaleimide compound (B') shows low crystalline properties, so that the resin composition is in a liquid form and it is not necessary to employ a solvent. It can be used directly. Further, the bismaleimide compound (B') has excellent affinity for general liquid vinyl compounds and can be diluted with vinyl groups. As a result it is able to prevent the generation of voids in a cured product of the resin composition, which voids result from the volatilization of a solvent. The absence of voids also provides a cured product with excellent thermal conductivity. Thermal conductivity is an important characteristic that is required for an adhesive for semiconductor elements and heat dissipating members to have.

Also in the bismaleimide compound (B''),  $R^6$  is a hydrocarbon group having three or more carbons. This prevents deterioration in the water absorption property of the cured product and makes deterioration in the properties of the resin composition (e.g., adhesion) under severe condition in water treatment such as a pressure cooker test (PCT). Also since,  $R^6$  is a hydrocarbon group having 6 or less carbons, it is able to prevent deterioration in the adhesive of the resin composition to metal surfaces that are likely to be oxidized, such as copper, which can happen when the resin composition becomes too much hydrophobic. In addition, the resin composition is able to maintain low crystallinity.

Also in the bismaleimide compound (B'),  $X^2$  is  $-O-$ , so that the cured product shows flexibility and shows excellent low stress property. To maintain adhesion to an object, it is very

important for the cured product to show excellent low stress even when it is exposed to high temperatures when a semiconductor, etc., is in use. Moreover, when  $X^2$  is-O-, the bis-maleimide compound (B') is in liquid form and is highly soluble in other components.

Also, since the bismaleimide compound (B') has a repeating number "n" of the polyether which is 50 or less, the resin composition has a viscosity that is practicable which would promote its use.

Also, the bismaleimide compound (B') helps adhesive resin composition comprising a filler (especially silver powder) to show excellent flowability and excellent adhesion.

#### Declaration

The requested comparison was undertaken. It is from the additional data that when the Sakurai maleimide compounds are employed in the resin composition of Herr et al., inferior properties resulted. The exemplified Sakurai maleimide compounds have structures that are not preferred for use in the present invention (a trifunctional structure or a structure having an aromatic ring other than an imide ring). The evaluated items are shown in the table 5 of the specification of the present specification. Poor results were obtained in all of the following three items: adhesion strength 1, warpage and reflow resistance. Table 5 of the specification shows results for the resin composition of claims 23-25.

A reason why such poor results shown in the table of the declaration were obtained is explained as follows: the composition of reference experiments 1 and 2 have very high viscosity, show poor coating performance and show poor adhesion to a bonding surface (Ag plated surface). Also, it is also considered as a main reason for the poor results that both of the resin compositions of the reference examples 1 and 2 show low flexibility after curing and low expansion when heated, etc., so that the degree of thermal expansion of the resin compositions are very different from that of the bonding surface.

Accordingly, it is difficult even for a person skilled in the art to select a maleimide compound from a number of compounds disclosed in Sakurai, which exerts excellent effects when used for the adhesive for the semiconductor elements and heat dissipating members, which

is an application of the resin composition of the present invention. In addition, as shown by the poor results of references experiments 1 and 2, even if the trifunctional maleimide or the maleimide compound having an aromatic ring other than an imide ring was used for the resin composition of Herr et al., both of which were actually used in the examples of Sakurai, no excellent results are obtained as an adhesive for semiconductor elements and heat dissipating members. Moreover, it is not possible even for a person skilled in the art to expect that there is an increase in all of the compared adhesion strength 1, warpage and flow resistance when the bismaleimide compound (B') is used, compared with the case of using of the trifunctional maleimide or the maleimide compound having an aromatic ring other than an imide ring.

Accordingly, it is submitted that a proper prima facie case has not been established, even considering the newly applied Chan patent. Further, should a prima facie case be deemed to have been established, the newly submitted Rule 132 declaration rebuts the prima facie case. The results shown in the specification are truly unexpected.

Withdrawal of the rejection is respectfully requested. Favorable action at the Examiner's earliest convenience is respectfully requested.

### CONCLUSION

All of the stated grounds of rejection have been properly traversed, accommodated, or rendered moot. Therefore, it is respectfully requested that the Examiner reconsider all presently outstanding rejections and that they be withdrawn. It is believed that a full and complete response has been made to the outstanding Official action and, as such, the present application is in condition for allowance. If the Examiner believes, for any reason, that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at the number provided.

It is not believed that extensions of time are required, beyond those that may otherwise be provided for in accompanying documents. However, in the event that additional extensions of time are necessary to prevent abandonment of this application, then such extensions of time are hereby petitioned under 37 C.F.R. 1.136(a), and any fees required therefor are hereby authorized to be charged to **Deposit Account No. 02-4300, Attorney Docket No. 033036.110.**

Respectfully submitted,

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